



## ORIGINALES

### Brain death diagnosis in victims of traffic accidents: process analysis

Diagnóstico de morte encefálica em vítimas de acidentes: análise do processo

Diagnóstico de muerte encefálica en víctimas de accidentes: análisis del proceso

Rosane Almeida-de Freitas<sup>1</sup>  
Cátia Millene Dell'-Agnolo<sup>2</sup>  
Elizabete de Almeida-Benguella<sup>1</sup>  
Luis Manuel Blanco-Donoso<sup>3</sup>  
Érica Cristina Ferreira<sup>1</sup>  
Sandra Marisa-Pelloso<sup>1</sup>  
María Dalva de Barros-Carvalho<sup>1</sup>

<sup>1</sup> Health Sciences Program of the State University of Maringá (UEM), Maringá, Paraná, Brazil.

<sup>2</sup> Graduate Program in Nursing of the UEM. Maringá, Paraná, Brazil.

<sup>3</sup> Program of Clinical Psychology and Health of the Autonomous University of Madrid, Spain

E-mail: [elizabetealmeidab@gmail.com](mailto:elizabetealmeidab@gmail.com)

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#### ABSTRACT:

**Objective:** Victims of external causes of trauma, caused either by traffic accidents or by violence in general, are mostly youngsters who evolve to brain death and potential donors. Considering that the time to determine brain death may interfere on the quality of the offered organs, the purpose of this study was to analyze the period of brain death diagnosis process.

**Material and Methods:** It is a retrospective, descriptive study on brain death diagnosis process and its duration in patients who are fatal victims due to external causes of trauma in a city in the Northwest of Paraná, Brazil, ranging from January to December 2012.

**Results:** The average of time for the period between the coma confirmation and the initial protocol for brain death determination in the four hospitals consisted of 18.90±13.62 hours; the average of protocol closure with Complementary Examination for the four studied hospitals consisted of 12±8 hours, and closure with clinical proof indicated 10±6 hours.

**Conclusion:** The data presented describe a failure in the entire brain death process, since coma detection until brain death diagnosis protocol closure, considerably increasing diagnosis time.

**Keywords:** Brain Death; External Causes, Diagnosis, Traffic Accidents

#### RESUMO:

As vítimas de causas externas por traumas, seja por acidentes de trânsito ou violência em geral, são em sua maioria jovens que evoluem para morte encefálica tornando-se potenciais doadores. Considerando que o tempo de determinação de morte encefálica pode interferir na qualidade dos

órgãos ofertados, o objetivo deste estudo foi analisar o tempo do processo de determinação de morte encefálica. Trata-se de um estudo retrospectivo e descritivo sobre o processo de determinação de morte encefálica e sua duração, em pacientes vítimas fatais por causas externas ocasionadas por traumas, em um município do Noroeste do Paraná Brasil, no período de janeiro a dezembro de 2012. A média de tempo entre período compreendido entre a constatação do coma e início do protocolo de determinação de morte encefálica, nos quatro hospitais analisados foi de  $18,90 \pm 13,62$  horas e a média de encerramento do protocolo com Exame Complementar dos quatro hospitais estudados foi de  $12 \pm 8$  horas e do encerramento com prova clínica foi de  $10 \pm 6$  horas. Os dados apresentados descrevem uma falha em todo o processo de morte encefálica, desde a detecção do coma até a finalização do protocolo de determinação de morte encefálica, aumentando consideravelmente o período de tempo de seu diagnóstico.

**Palavras chave:** Morte Encefálica; Causas Externas, Diagnóstico, Acidentes de Trânsito.

## RESUMEN:

**Objetivo:** Las víctimas de las causas externas de trauma, causadas ya sea por accidentes de tránsito o por la violencia en general, son en su mayoría jóvenes que evolucionan a muerte encefálica y posibles donantes. Teniendo en cuenta que el tiempo para determinar la muerte encefálica puede interferir en la calidad de los órganos ofrecidos, el propósito de este estudio fue analizar el período del proceso de diagnóstico de muerte encefálica.

**Material y métodos:** Es un estudio descriptivo retrospectivo sobre el proceso de diagnóstico de muerte encefálica y su duración en pacientes víctimas mortales por causas externas de traumatismo en una ciudad del noroeste de Paraná, Brasil, desde enero a diciembre de 2012.

**Resultados:** El promedio de tiempo para el período entre la confirmación del coma y el protocolo inicial para la determinación de la muerte encefálica en los cuatro hospitales fue de  $18.90 \pm 13.62$  horas; el promedio de cierre del protocolo con Examen Complementario para los cuatro hospitales estudiados fue de  $12 \pm 8$  horas, y el cierre con prueba clínica indicó  $10 \pm 6$  horas.

**Conclusión:** Los datos presentados describen una falla en todo el proceso de muerte encefálica, desde la detección de coma hasta el cierre del protocolo de diagnóstico de muerte encefálica, lo que aumenta considerablemente el tiempo de diagnóstico.

**Palabras clave:** Muerte encefálica; Causas externas, Diagnóstico, Accidentes de tráfico.

## INTRODUCTION

Traffic accidents are the eighth cause of death in the world, and the leading cause of death among young people between 15 and 29 years of age <sup>(1)</sup>. Cranioencephalic trauma is among the main causes that lead patients to evolve to brain death, becoming potential donors of organs and tissues for transplants <sup>(2)</sup>.

In 2014, there were 7.898 solid organ transplants such as the kidney, heart, lungs, pancreas and liver. However, in the same year, the waiting list for an organ reached 20.367 people, that is, only 39% of the people who needed a transplant to survive were treated <sup>(3)</sup>.

One of the major problems faced in relation to organ donation is due to the fact that the diagnosis of brain death is not uniform in all countries. Brazil complies with the legislation established by the Federal Council of Medicine, where the diagnosis is made up of two clinical tests: an apnea test and the performance of a complementary confirmatory diagnostic graphic examination. The two clinical tests have an interval of 6 hours between them in the case of patients with an age greater than two years, and must be performed by two different doctors. When the patient is less than two years old, the interval varies according to age <sup>(4)</sup>. The complementary confirmatory examination can be performed after the opening of the protocol or after the second clinical test. The exams accepted in Brazil for diagnosis are made by reviewing the detection of brain electrical activity (Electroencephalography), cerebral blood flow

(transcranial Doppler and cerebral arteriography), or cerebral blood circulation (Spect of cerebral perfusion) <sup>(5)</sup>.

Another difficulty in the diagnosis of brain death is the acceptance and understanding of this concept by the general population. Most of the people do not understand their meaning well and believe that the potential donor and deceased still have conditions to return to life <sup>(6)</sup>.

Once the diagnosis of brain death, it is possible to donate organs and tissues for transplants and, in the face of family refusal, it is recommended to suspend therapeutic support procedures <sup>(7)</sup>. In case of authorization for the donation of organs and tissues for transplants, time is crucial for the quality and viability of organs. The effectiveness of organ and tissue donation is directly related to the time and accuracy with which the donation process is performed <sup>(5, 8)</sup>.

The victims of traumas from external causes, whether due to traffic accidents or violence in general, are mostly young people who evolve to brain death, becoming potential donors. Considering that the time of determination of the brain death can interfere in the quality of the available organs, the purpose of this study was to analyze the time of the process of determination of brain death in a municipality of the Northwest State of Paraná in Brazil.

No studies were found in the national literature analyzing the duration of the process of brain death diagnosis until the present moment.

## METHODOLOGY

It is a retrospective and descriptive study about the process of brain death diagnosis and its duration, in fatal victims of external causes caused by traumas in the municipality of Maringá, Paraná, South of Brazil, in the period from January to December 2012.

The deaths occurred in the study period were analyzed through the verification of the monthly reports sent to the Commission of the Organization of Organ and Tissue Recruitment for Transplants - 15th Regional Health, through the Intrahospitalary Committees of Organ and Tissue Donation for Transplants, from the hospitals of Maringá and the metropolitan region that had an acting commission. Among these hospitals, three were private agreed with the Public Health System and one was a University hospital. The hospitals were identified as Hospital A (private / philanthropic); Hospital B (private, philanthropic and public); Hospital C (private and public); and Hospital D (University Hospital).

From the reports, a database was constructed using an Excel spreadsheet 2010, constituted by the victims of trauma from external causes that evolved to death by brain death. The data were collected from the analysis of the medical histories, together with the variables of gender (categorized in masculine and feminine) and the age (from two to 70 years). The outcome variables were: interval between the observation of the irresponsible coma and the beginning of the brain death determination protocol, as well as its duration. Patients who had no identification were excluded.

The data collection and analysis of the medical records was done once the permission for the research requested to the Commission of the Organization of Organ and Tissue Recruitment for Transplants and to the hospitals participating in the study was obtained, and through the approval of the Human Research Ethics Committee. It was requested the release of the Consent Form, because it was a documentary investigation with individuals who died.

After the collection, the data were analyzed using the statistical program EpiInfo 3.5.1.

## RESULTS

Of the 31 patients victims of trauma who developed brain death in the hospitals studied, 24 (77.4%) were male and 7 (22.6%) female. The average age was 34.37 years, ranging from 6 to 60 years.

Among the causes of hospital admission, 15 patients (48.4%) were victims of traumatic brain injury, and 16 (51.6%) of polytrauma. The average number of days of admission was 15.06 days, ranging from two to 30 days. The majority of patients (96.8%) were admitted to Intensive Care Units.

The protocols were carried out in a private / public hospital (7-22.6%) in what we appointed Hospital A; in a private / philanthropic / public hospital (14-45.2%), categorized as Hospital B; in a hospital with particular attention and at the same time by the Public Health System (9-29%), that is, in a C Hospital; and in a University hospital or Hospital D (1- 3.2%).

The time interval between the verification of the coma and the start of the brain death determination protocol, as well as the duration of the latter in the hospitals studied, can be seen in table 1.

**Table 1.** Interval of time between the verification of the coma and the beginning of the brain death determination protocol and its duration in the hospitals studied, from January to December 2012. Maringá, Paraná, Brasil, 2015.

Place	n (%)	Start interval	Duration of	Rank	
		protocol* BD (hours)	protocol BD (hours)	Min.	Máx.
		Average and SD	Average and SD		
<b>Hospital A</b>	7 (22,6)	28±17	10±4	6	18
Closure of the protocol with EC	3 (42,9)	32±23	11±2	10	13
Closure of the protocol with PC	4 (57,1)	25±13	10±6	6	18
<b>Hospital B</b>	14 (45,2)	20±13	11±6	6	24
Closure of the protocol with EC	9 (64,3)	18±14	10±5	6	21
Closure of the protocol with PC	5 (35,7)	23±12	12±7	6	24
<b>Hospital C</b>	9 (29,0)	8±9	13±10	6	39
Closure of the protocol with EC	5 (55,6)	9±9	15±12	6	39
Closure of the protocol with PC	4 (44,4)	6±10	8,±3	6	13
<b>Hospital D</b>	1 (3,2)	51	7	-	-
Closure of the protocol with EC	-	-	-	-	-
Closure of the protocol with PC	1 (100)	51	7	-	-

n=31; EC= complementary examination; PC= clinical proof; BD= brain death; SD= standard deviation.

\* Period between the verification of the coma and the beginning of the brain death determination protocol.

Of the 31 patients diagnosed with confirmed brain death, 11 (35.5%) were donors of multiple organs and / or tissues; 4 (12.9%) were discarded for donation due to clinical contraindications; and in the case of 16 patients (51.6%), the family members refused the donation.

The mean time between the period between the verification of the coma and the beginning of the brain death determination protocol in the four hospitals was  $18.90 \pm 13.62$  hours.

On the other hand, the mean closure of the protocol with complementary examination of the four hospitals was  $12 \pm 8$  hours and the closure with a clinical test of  $10 \pm 6$  hours.

## DISCUSSION

Currently there is much discussion about the donation of organs and tissues for transplants, family refusal, logistical problems of organ transport and many other factors that can negatively interfere with donation. However, there are few studies that address the process of determining brain death. In addition to being a mandatory medical diagnosis and notification required to the Central Notification, Collection and Distribution of Organs, it is a right of every patient and, the longer the time for its realization in cases of donation, the lower will be subsequently the viability of the organs and the quality of the graft, in addition to the inadequate occupation of beds within the ICU. The brain death diagnosis is the main point for the development of the process of organ and tissue transplantation <sup>(5)</sup>.

The period between the verification of the coma and the beginning of the brain death determination protocol was high in all the hospitals studied. Once the coma was confirmed, endocrine-metabolic, hemodynamic disturbances, any alteration in temperature and the use of sedative, hypnotic and / or neuromuscular blocking drugs were discarded and with the individual with a diagnosis defined by a neurological cause that explains the coma, the brain death diagnosis protocol must be initiated regardless of the possibility of donation, or not, of organs <sup>(5)</sup>. ICU professionals and emergency units must be trained for early recognition of coma and patient preparation for the start of the brain death diagnosis protocol, focusing on the stabilization of the effects caused by brain death and thus demanding extreme agility in bureaucratic processes <sup>(9)</sup>.

Although there are well elaborated protocols by the National System and State Transplant Centers, in this study it was observed that there is no standardization in the institutions regarding the beginning of the brain death diagnosis process, due to the variation of the observed time. This delay can interfere directly in the viability and quality of the organs and consequently in the effectiveness of the donation process. Some studies suggest that in most cases, 89.2% of the entire donation process occurs inadequately <sup>(8)</sup>.

The delay in the verification of coma and the determination of the brain death can be associated to the fact that in Brazil many serious patients remain in massified emergency units, not receiving the necessary attention and compromising the whole process of diagnosis of brain death, due to lack of beds of ICU <sup>(10)</sup>.

The mean closure of the protocol with clinical test in the four hospitals analyzed was  $10 \pm 6$  hours. Currently, the protocol for the determination of brain death in Brazil

involves performing two clinical tests with an interval of 6 hours for patients over two years of age, and a complementary examination test that can be performed at any time <sup>(4)</sup>. In the State of Paraná, one of the clinical tests performed for the diagnosis of brain death must be performed by a specialist, neurologist or neurosurgeon <sup>(5)</sup>, which can make diagnosis difficult and cause a delay in the diagnosis since it is a need to availability of a specialist, often unavailable in 24-hour on-call hospitals.

Regarding the closure of the protocol with complementary examination test, the mean in the four hospitals was  $12 \pm 8$  hours. A longer period was observed for the closure of the protocol with complementary examination, which may denote a possible delay in its completion. One of the most used tests for the diagnosis of brain death is the Transcranial Doppler because it is easy to access, portable, and can be performed at the bedside. However, the municipality studied has only two doctors trained to perform it, which may hinder or prolong the protocol's finalization.

Once the diagnosis of brain death has finished, the patient has to be evaluated about the possibility of being an organ donor. The diagnosis should be explained to the family by the medical team and the professionals of the hospital donation and transplant commission must be activated to verify the contraindications and exclusions for the donation, as well as when applicable, interview the family members about the donation. If the family authorizes the donation, support for the now potential organ donor should be maintained until the moment of organ harvesting <sup>(5)</sup>.

The maintenance and early detection of problems and possible complications involving potential donors are extremely important factors that health professionals must master, since this fact is directly related to the quality and viability of the organs that can be donated <sup>(11)</sup>.

In general, the time to start and finish the protocol was high in all hospitals, exceeding the recommended minimum time of 6 hours. In this way, the importance of training health professionals, training through the members of the professionals of the hospital donation and transplant commission, and the support of the hospital administrative in the human resources, logistics and structure issues to provide technical assistance to the potential donor <sup>(8, 12)</sup>.

Finally, this study should be analyzed considering some of its limitations. Although four hospitals were studied, the number of patients in brain death was small, limiting the sample. Only a small sample of the population was analyzed, the patients victims of traumas from external causes. However, as documented in the literature, this part of the population is a potential donor due to the usually young age and organ viability.

## CONCLUSION

The data describe a failure in the entire brain death process, from the detection of the coma until the end of the brain death determination protocol, considerably increasing the time of diagnosis.

Because it is a young population, a potential donor of organs, a delay in the process may interfere with the viability of the organs donated, decreasing a quality of the implant, as well as causing a great number of family refusals in donation.

A better professional qualification for brain death diagnosis and maintenance of the organs in patients in brain death could contribute to improve the time interval of between the coma identification and the conclusion of the brain death diagnosis process and consequently decreasing maintenance time by improving the viability of the organs to be donated.

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